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ABSTRACT

The document, part of a series of chapters described in SO 011 759, describes a model that incorporates organizational politics and environmental dependence into a study of the effects of growth and decline on the number of school personnel. The first section describes the original model which assumes that as the number of students in a district changes, the number of employees should change proportionately and that the process should work the same way in growth and decline. The authors argue that the weakness of this model is that it does not indicate the political process of personnel change during periods of growth and decline. The second section discusses the two-part model. The first part deals with the effect of carrying capacity (the upper limit of the size of population that can be sustained in a particular system) on the number of personnel. Carrying capacity is determined by three variables: exogenous environmental variations (enrollments and finances), internal competitive relations (organizational politics), and history (social, political, and cultural characteristics of the local environment). The second part focuses on the responsiveness or speed of response of administrators to change in their carrying capacity. The third section discusses application of the model to California school districts, using yearly counts of enrollments and the sizes of four personnel categories: teachers, administrators, pupil service employees, and calssified non-professionals. Results indicate that the politics of growth and decline are vastly different. Competitive interactions are stronger in decline, carrying capacities for most personnel components are lower at a given level of enrollment in decline, and organizational systems respond more slowly to changes in decline. (Author/KC)

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PART II - Chapter 2

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Final Report for

# DYNAMIC MODELS FOR CAUSAL ANALYSIS OF PANEL DATA.

## INTERNAL POLITICS OF GROWTH AND DECLINE*

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# Internal Politics of Growth and Decline

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The empirical literature on organizations has in recent years been preoccupied with the problem of size and structure, particularly with the more narrow administrative intensity problem (for reviews of this literature, see Freeman, 1973; Scott, 1975; Kimberly, 1976). Almost without exception, the early work that explored the forces that shape the size of administrative components in organizations took a decidedly rationalist perspective. Blau, who did more than anyone else to advance the study of organizational internal demography, set the tone. Administrators were assumed to deal with problems of coordination of divided labor. Rational organizations hire (and fire) administrators according to variations in coordi-

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nation needs. The main variations in the need for coordination were assumed to vary with the size of the organization. Thus Blau and many others analyzed the relationship between size and the proportion of workers in the administrative category. This work produced some valuable insights but also raised serious methodological and theoretical questions. The methodological questions have to do with problems of definitional dependency (see Freemen and Kronenfeld, 1974) and model specification (which issues became clear when cross-sectional designs were replaced by longitudinal designs; see M. Meyer, 1971; Freeman and Hannan, 1975). The theoretical issues concern system closure and organizational politics. Conventional models of administrative intensity presume that organizations behave as closed systems such that the size of various personnel components adjust only to internal exigencies. Moreover, the adjustment is mechanical and rational; it does not involve struggles among personnel components over scarce organizational resources, namely positions. Much of the thrust of this book involves reversing positions on these two issues.

The work reported in this chapter is an attempt to inject organizational politics and environmental dependence into models of organizational demography. It is an extension of our earlier work (Freeman and Hannan, 1975), which was one of the first empirical studies to depart from the rational tradition on organizational demography. After briefly reviewing the earlier work, we propose a dynamic model for the growth and decline of personnel components in organizations characterized by conflicts over positions. Then we estimate the model for California school districts. Our results support the contention that growth and decline processes differ. However, the new model reveals that the processes are complex and that not all of our previous arguments hold up well.

## The Original Model

Our earlier work employed a model that mixed organizational politics and administrative rationality. We reasoned as follows. Each district was assumed to face community norms that limited changes in pupil-teacher ratios, a norm of constant class size.

o, as the number of students in a district changes, the number of eachers employed ought to change proportionately. Moreover, his process should work the same way in growth and decline. Regarding the other personnel categories (administrators, pupil service employees, and classified employees), we reasoned differently. s long as the number of students was growing, administrative ationality would dictate that the sizes of each of these components ould be adjusted to changes in the number of teachers. To be oncrete, the growth model was

$$\frac{dT}{dt} = a + bT + cE \tag{1}$$

$$\frac{dX_j}{dt} = d + eX_j + fT \tag{2}$$

here $E$ denotes size of enrollments, $T$ the number of teachers, nd $X_j$ is the size of the $j$th nonteaching personnel category.

We argued for the same type of model in decline. However, e hypothesized that organizational politics would lead the paramters of the second equation (but not the first) to differ from those hat hold in growth. In particular, we proposed that declining disricts would maintain higher levels of nonteaching personnel than ould be the case for otherwise similar growing districts.

Notice that organizational politics entered this model only the postulated difference between growth and decline. While we eel that this simple model served a very useful purpose in introucing political considerations into formal empirical analysis of rganizational demography, we now conclude that we did not go ar enough. Surely both the growth process and the decline process re more political than this model indicates. The growth or decline f any personnel component is surely affected by the sizes of other omponents. For example, the earlier model did not relate the rowth or decline in the number of teachers to the number of adinistrators. But, insofar as the various categories are competing r a limited budget, this sort of dependence seems likely. One of ur major goals in this chapter is to extend the earlier model to corporate more general organizational politics.

## A Competition Model

Following the strategy outlined in Chapter Six, we break the modeling effort into two parts. The first deals with the factors that affect the equilibrium levels of personnel component sizes. So, for example, we will investigate the way in which the carrying capacity for administrators in a district is affected by various internal and external conditions. The second issue focuses on dynamics, the time path of changes from some starting point toward the carrying capacity. Here we will focus, for example, on the responsiveness or speed of response of administrators to some change in their carrying capacity.

Consider first the question of carrying capacities. Recall that a carrying capacity is defined as the upper limit of the size of the population that can be sustained in a particular system. In the most general terms, we expect that the carrying capacity for any personnel component is determined by three classes of variables: *exogenous environmental variations* (such as enrollments and finances), *internal competitive relations* (such as organizational politics), and *history* (such as inertial social, political, and cultural characteristics of the local environment). So the size of any particular category is determined by the availability of environmental resources on which it depends, on the sizes of the competing components and the intensity of competition, and on stable characteristics of the organization and its environment that favor this particular category. We can summarize these assertions as follows. Let $X_{ij}^{*}(t)$ denote the carrying capacity of the $i$th local environment for the $j$th personnel category; let $X_{ij}(t)$ denote the current size of the category; $Z_{ij}(t)$ summarizes the variable environmental conditions and $M_{ij}$ the constant conditions (history). Then the model states:

$$X_{ij}^{*} = f_j\,(X_{i1}(t), \ldots, X_{ij-1}(t), X_{ij+1}(t), \ldots, X_{ij}(t), Z_{ij}(t), \mu_{ij}) \qquad (3)$$
$$(i = 1, \ldots, I;\ j = 1, \ldots, J)$$

To keep the model tractable, we choose a simple form for the dependence of the carrying capacities on the three classes of variables. We assume that the dependence is linear and that the dependence parameters are constant over local environments. Thus

$$X_{ij}^{*} = \alpha_j + \sum_{k \neq j} \beta_{jk} X_{ik}(t) + \gamma_j Z_{ij}(t) + \mu_{ij} \qquad (4)$$

The parameters of (4) are usually referred to by bioecologists as the *parameters of the niche* of the entity in question. The coefficients of the other components, the $X_{ik}$, are of special theoretical importance. They are in fact what we called *competition coefficients* in Chapter Six. They indicate the impact of a unit of one component on the carrying capacity of the other. They can, of course, be positive, negative, or zero. When both $\beta_{kj}$ and $\beta_{jk}$ are negative, the two components are said to interact *competitively*. When $\beta_{kj}$ is negative but $\beta_{jk}$ is zero, we will speak of *j*'s *interference* with *k*. In the case where both are positive, the relationship is termed *symbiotic*. When $\beta_{kj}$ is positive but $\beta_{jk}$ is zero, we will refer to *j*'s *facilitation* of *k*. Finally, when one is positive and the other is negative, the relationship is one of *predation*. We will follow the usual ecological practice of referring to the $\beta_{kj}$ as *competition coefficients* where this does not give rise to ambiguities.

Next we consider the dynamic structure. In our earlier work, we argued for a partial adjustment model where the speed of adjustment may differ by category and in growth and decline. We continue to use the simplest continuous-time partial adjustment model: a linear model (for further discussion of such models, see Hummon, Doreian, and Teuter, 1975; Nielsen and Hannan, 1977; Doreian and Hummon, 1977):

$$X_{ij}(t + \Delta t) - X_{ij}(t) = r_j \Delta t \left[ X_{ij}^{*}(t) - X_{ij}(t) \right]$$

or, taken to the limit

$$\frac{dX_{ij}}{dt} = r_j \left[ X_{ij}^{*} - X_{ij} \right] \quad (j = 1, \ldots, J) \qquad (5)$$

The parameter $r_j$ is also of considerable theoretical importance. It indicates the level of responsiveness of a personnel category to changes in its carrying capacity (or, more precisely, to gaps between current levels and the carrying capacity). When there is no structural inertia, $r_j = 1$, the component adjusts completely in the interval $\Delta t$. At the other extreme, as $r_j$ approaches zero, the

component does not adjust at all. Clearly, the responsiveness parameter $r_j$ indicates the fraction of the required adjustment that is made in the time unit we specify. We choose to parameterize the model in yearly time units. Thus $r_j$ will be the fraction of the gap that is made up each year. We are interested in contrasting this parameter across components and for each component between growth and decline.

We complete the model by making the obvious substitution of (4) into (5):

$$\begin{aligned}\frac{dX_{ij}}{dt} &= r_j \left[\alpha_j + \sum_{k \neq j} \beta_{jk} X_{ik} + \gamma_j Z_{ij} + \mu_{ij} - X_{ij}\right] \\ &= a_j + \sum_{k \neq j} b_{jk} X_{ik} + c_j Z_{ij} + m_{ij} - r_j X_{ij} \qquad (6) \\ &= a_j + \sum_{k} b_{jk} X_{ik} + c_j Z_{ij} + m_{ij}\end{aligned}$$

where

$$\begin{aligned} a_j &= r_j \alpha_j \\ b_{jk} &= \begin{cases} -r_j \text{ when } j = k \\ r_j \beta_{jk} \text{ otherwise} \end{cases} \\ C_j &= r_j \gamma_j \\ m_{ij} &= r_j \mu_{ij} \end{aligned} \qquad (7)$$

## Estimation

The equations in (6) constitute a system of $IJ$ first-order linear differential equations. To proceed toward estimation of the fundamental parameters just discussed, we must rewrite (5) in matrix form. Let

$$\frac{dX}{dt} = \left(\frac{dX_1}{dt}, \ldots, \frac{dX_J}{dt}\right)'$$

Then

$$\frac{dX}{dt} = ai' + BX + CZ + M \tag{8}$$

where

$a = (a_1, \ldots, a_j)'$; $i' = (1, \ldots, 1)$ is $(1 \times I)$;

$B$, $X$, and $M$ are $(J \times I)$ and $Z$ is $(1 \times I)$.

The system in (8) has solution

$$X(t) = B^{-1} ai' (C^{B\Delta t} - I) + e^{B\Delta t} X(t_0) + e^{Bt} \int_{t_0}^{t_1} e^{Bt_0} CZ' ds + B^{-1} M (e^{B\Delta t} - I) \tag{9}$$

As in our previous analysis, we assume that the variable environmental factor changes linearly over $\Delta t = t - t_0$. Then (9) reduces to

$$X(t) = B^{-1} ai' (e^{B\Delta t} - I) + e^{B\Delta t} X(t_0) + B^{-1} C (e^{B\Delta t} - I) Z(t_0) + B^{-1} C \left[ \frac{e^{B\Delta t} - I}{\Delta t} - I \right] \Delta Z + B^{-1} M (e^{B\Delta t} - I) \tag{10}$$

This has a form,

$$X(t) = a^* i' + B^* X(t_0) + C_1^* Z(t_0) + C_2^* \Delta Z + M^* \tag{11}$$

that is amenable to regression analysis.

The equations in (11) are of the form proposed by Coleman (1968)—see also Kaufman (1976)—with the exception of $M^*$. The

entries in $M^*$ are unobservable variables that summarize the effects of history. As such, they are forced into the disturbance term that is implicitly specified when regression analysis is applied to the integrated form of the continuous time model. So, if we were to proceed in the conventional manner, we would estimate:

$$X(t) = a^*i + B^* X(t_0) + C_1^* Z(t_0) + C_2^* \Delta Z + U \quad (12)$$

where

$$U = M^* + E$$

and $E$ is a matrix whose entries are random measurement errors and other sources of error. There is no problem with the regression assumption that disturbances be uncorrelated with regressors in the case of $E$. However, this essential assumption cannot apply with respect to $M^*$. The constant factors in each environment affect $X(t_0)$ as well as $X(t)$ so that $M^*$ must be correlated with $X(t_0)$ —for more complete discussion of the problem, see Hannan and Young (1977). Consequently, application of ordinary least squares regression analysis to (12), ignoring history, will produce biased estimates of the fundamental parameters.

With only two waves of observations (at $t_0$ and $t$), there is no simple solution to this estimation problem. However, with more waves of observations, a pooled cross section and time series analysis can be estimated in a way that circumvents the problem. The logic and procedures are discussed in Hannan and Young (1977). In particular, we propose to treat the historical factors not as parameters to be estimated but random variables drawn from a single distribution with finite variance. Then we can apply generalized least squares procedures that have been shown to have good small sample properties.

In fact, we do not use any of the generalized least squares estimators discussed in the econometric literature (see Nerlove, 1971). The reason is that we wish to introduce one further complication. In our earlier work, we found evidence of heteroscedasticity: The variance of the disturbances appeared to be correlated with the size of the organization. Evidence of a similar pattern

emerged when we applied Nerlove's modified generalized least squares procedure to the pooled data. We corrected for this problem in our earlier work by employing weighted least squares. This suggests that we form an estimator that combines generalized least squares correction for the historical factors and weighted least squares for heteroscedasticity in the random portion of the disturbance. Such a combined estimator has been developed and employed by Nielsen and Hannan (1977). It involves an application of Henderson's (1952, 1963) method of estimating variance components. For details, see Nielsen (1974) and Nielsen and Hannan (1977). We refer to the estimator as weighted generalized least squares (WGLS).

So the first step in empirical analysis is to obtain WGLS estimates of the coefficients of (11). Then given $\hat{a}^*$, $\hat{B}^*$, $\hat{C}^*_1$, and $\hat{C}^*_2$, we work backwards to obtain estimates of the fundamental parameters following the eigenvalue method proposed by Coleman (1968, p. 451). We first estimate the internal or endogenous part of the system using the relationship:

$$\hat{B}^* = e^{B\Delta t} \tag{13}$$

and the decomposition

$$\hat{B}^* = \hat{V}^* \hat{\Delta} \hat{V}^{*-1}$$

where $\Delta$ is the diagonal matrix whose entries are eigenvalues of $B$ (equal to those of $B^*$) and $V$ is the matrix whose columns are the associated eigenvectors (see Coleman, 1968, p. 251). Then it follows that

$$\hat{B} = \hat{V}^* \left(\frac{1}{\Delta t} \ln \hat{\Delta}\right) \hat{V}^{*-1} \tag{14}$$

Once we have estimated $B$, the other terms in (8) are obtained by straightforward matrix operations. Finally, we use the identities in (7) to recover estimates of the fundamental demographic parameters.

This set of procedures has one disadvantage. The strategy for estimating the fundamental parameters is somewhat indirect. As we noted earlier (Freeman and Hannan, 1975, p. 222), the nonlinear operations required to go from (10) to (8) do not preserve the asymptotic efficiency of our estimators. Nor do we have sampling distributions for the fundamental parameters. Thus all statistical testing must be done on the integrated form (10). Nonetheless, this procedure does yield consistent estimators of fundamental parameters.

## Data

The empirical analysis reported hereafter conforms as closely as possible to that done earlier (Freeman and Hannan, 1975). We use yearly counts of enrollments and the sizes of four personnel categories from California school districts. The personnel categories are teachers ($T$), administrators ($A$), pupil service employees ($P$) (for example, librarians and guidance counselors), and classified nonprofessionals ($C$) (for example, cafeteria workers and secretaries).

In the earlier work, we employed two- and four-year lags. For each lag, we separated the 823 school districts into those whose enrollments grew each year (growers), those whose enrollments declined each year (decliners), and the rest. We analyzed only growers and decliners. Here we use data from the 1971–1975 period and a two-year lag; that is, we estimate effects for the pooled 1971–1973, 1972–1974, and 1973–1975 periods. We now define growers as those districts whose enrollments grew 10 percent or more over the period. Decliners are defined as those districts whose enrollments declined 10 percent or more. This criterion yields 170 growers and 223 decliners.

Table 1 reports the means for all variables for the growers and decliners. The declining districts' initial mean enrollment was about a third larger than that for growers. However, the average class sizes were quite similar initially (23.2 for growers and 23.8 for decliners). The ratio of administrators to teachers was also quite close (.069 and .068 for growers and decliners respectively). By 1975, the mean enrollments had almost reversed. However, av-

erage class size had declined considerably for declining districts, and the *A/T* ratio had gone from .068 to .077. Similarly, the average levels of the other two elements in what we called the "supportive component," *P* and *C*, also resisted decline. The means for both *P* and *C* actually *increased* over the period of enrollment decline.

**Table 1. Means of Selected Variables.**

| | *Growers* | | *Decliners* | |
|---|---|---|---|---|
| | *1971* | *1975* | *1971* | *1975* |
| Average daily attendance (*E*) | 3447 | 4432 | 4584 | 3762 |
| Teachers (*T*) | 143 | 181 | 191 | 178 |
| *ADA/T* | 23.2 | 23.2 | 23.8 | 20.8 |
| Administrators (*A*) | 10.0 | 11.8 | 13.9 | 13.1 |
| *A/T* | .069 | .065 | .068 | .077 |
| Pupil service employees (*P*) | 9.6 | 12.9 | 9.6 | 10.3 |
| Classified employees (*C*) | 78.4 | 108.7 | 99.0 | 110.7 |
| *N* = | 170 | 170 | 223 | 223 |

Looking only at the means, we see that one of our earlier arguments does not fare well: Class size does not appear to remain constant in growth and decline. Our other broad argument is sustained: The supportive component resists decline; it appears to do so more effectively than the "direct component," *T*.

We turn now to examine whether this pattern holds for a properly specified multivariate, dynamic model. As we have discussed, the first step involves estimating, by WGLS, a series of linear models with lagged dependent variables. The estimated regression coefficients for enrollments and change in enrollments were always significant at the .05 level. However, some of the effects of one component on another were not. When we used these estimates to solve for the parameters of the dynamic model, we obtained several complex roots. We believed that this was due to the unstable estimates of the few insignificant variables. Therefore, we eliminated the insignificant variables, reestimated all equations, and solved for the fundamental parameters. This time, all rates were real, and the procedures we outlined earlier went through straightforwardly.

## Empirical Results

Our main interest is in contrasting the organizational demography of growth and decline. Our model separates the organizational demography problem into three parts: (1) competition among components for fixed resources; (2) changes in resource levels; and (3) responsiveness to changes in carrying capacities (determined by levels of resources and sizes of competitors). We turn first to a consideration of the results on competition.

*Competitive Structure.* We allowed the possibility that the upper level on the size of any component, or its carrying capacity, depends on the size of every other component. The patterns of dependencies that emerge in analysis of the data are simpler than that. Table 2 contains the matrices of competition coefficients for

**Table 2. Estimated Competition Coefficients (Community Matrices).**

| | | *Growers* | | |
|---|---|---|---|---|
| | *T* | *A* | *P* | *C* |
| *T* | 1.0 | | .616 | .156 |
| *A* | .071 | 1.0 | −.136 | −.004 |
| *P* | .127 | | 1.0 | −.006 |
| *C* | | | | 1.0 |
| | | *Decliners* | | |
| | *T* | *A* | *P* | *C* |
| *T* | 1.0 | 1.90 | | |
| *A* | .076 | 1.0 | | |
| *P* | .115 | −.016 | 1.0 | −.038 |
| *C* | −.152 | 5.54 | −2.14 | 1.0 |

*Note:* Entries are $\beta_{jk}$ in (4). Column variables take the role of $k$ and row variables, $j$. See Table 1 for explanation of categories ($T$ = Teachers).

growing and declining districts. Recall that when $\beta_{kj}$ is negative, the carrying capacity for component $k$ declines with the size of component $j$. In this case, component $j$ is said to *interfere* with $k$. If $\beta_{jk}$ is also negative, the two are said to *compete*. Positive coefficients, of course, have the opposite interpretation.

A matrix of competition coefficients for a system is often called a *community matrix*. Such a matrix has the advantage of making plain the pattern of dependencies in a system. Look first at the positioning of zero entries in growth and decline. In the matrix for growing districts, one row and one column have the maximum number of zero entries. In fact, these are the only zero entries in the matrix. The row contains the competition coefficients for classified employees (or nonprofessionals) with other components. The growth of this component depends only on external resources; in other words, in growth none of the components either interfere or facilitate the growth of the nonprofessional staff. At the same time, *C* affects the carrying capacity of every other component. It interferes with both administration and pupil services but increases the carrying capacity for the teaching component.

Administration is almost a mirror image. It does not affect any other component but is affected by every component. Both of the other nonteaching components, *P* and *C*, impede the growth of administration.

The pattern of zeroes suggests a hierarchical structure of dependencies. The level of *C* adjusts independently to the level of resources. Once *C*'s carrying capacity has been determined, the upper levels for *T* and *P* are determined (where *T* and *P* stand in a symbiotic relationship to each other but have different relations to the autonomous component, *C*). Finally, the carrying capacity for administration is determined jointly by the levels of all of the other components.

The picture for decline is very different. Now the zero entries are all in the upper right-hand corner of the matrix. Neither *T* nor *A* are affected by either of the other components. Both the teaching staff and administration adjust only to each other and to the outside environment. At the second level in the hierarchy of dependencies, *P* and *C* adjust to each of the other components.

What does this mean? We read these patterns as indicating that the competitive position of the administration is very different in growth and decline. When enrollments are growing, the administrative staff appears to get only the remainder of the resource pie. However, when enrollments are declining, administration shifts

to a more controlling position in the political struggle for resources. The administrative and teaching staffs stand in a symbiotic relationship in decline. They appear to jointly manage their dependence on the outside environment, unconstrained by the other components. Administration shifts to an active, dominating position in the organizational politics in decline.

Another aspect of the broad patterns deserves attention. The entries in the community matrix for decliners are consistently larger than is the case for decliners. It is worth formalizing this difference in *intensity of interaction*. A simple measure of intensity of interaction is the mean of the absolute values of all off diagonal terms in the community matrix. For growers, the average intensity is .093; for decliners, the average intensity is .945. This tremendous difference is due in part to the very large dependence coefficients for *C* in decline. But even when we ignore the rows and columns involving *C* there is a substantial difference in intensity between growth and decline. The average intensities, ignoring terms involving *C*, are .158 for growers and .351 for decliners. Therefore we conclude that *the intensity of competitive interactions among personnel components is greater in decline than in growth.*

This conclusion regarding intensity of interaction among components supports our earlier reasoning about the political nature of organizational decline. As we mentioned earlier, our earlier work treated the growth process as administratively rational and only the decline process as political. In the current model, both are political. Now we find that *it is the intensity of the competitive interactions, together with the patterns of interactions, that distinguishes growth and decline.*

Finally, we must note the position of the teaching component in the resource competition process. No component interferes with the growth teaching staff (that is, there are no negative entries in the two rows for *T*). Rather, a large supportive component increases the carrying capacity for teachers (in growth, it is *P* and *C* that do so, while in decline it is *A*). Moreover, teachers on the whole do not lower carrying capacities for other components (the only exception is for *C* in decline). At any given level of enrollments, the larger the size of the teaching staff, the larger the administrative staff and the pupil service staff.

*Carrying Capacities.* The next step is to examine how carrying capacities for components are determined. Unlike the previous findings, our earlier model made clear predictions concerning carrying capacities (although we used different language). We claimed that the relationship of the size of $T$ to enrollments would be the same in growth and decline. We also argued that the supportive component ($A$, $P$, and $C$—but especially $A$) would resist decline. That is, we hypothesized that a given enrollment would support more supportive personnel in decline. Of course, we have now altered the model substantially, and it is not clear that the same reasoning holds. Nonetheless, it is informative to address the questions in terms of $\hat{\alpha}_j$, $\hat{\beta}_{jk}$, and $\hat{\gamma}_j$, the parameters of the niche of each component.

Estimates of the niche parameters, the coefficients of the determinants of carrying capacities, are presented in Table 3. Only $\hat{\alpha}_i$ and $\hat{\gamma}_i$ are new since the $\hat{\beta}_{jk}$ are the entries in the community matrices just discussed. While there is some variation in the $\hat{\alpha}$'s, they are all small relative to other differences in the model. Consequently, we focus on the $\hat{\gamma}$'s, the effects of enrollments.

The four components fall into two groups. The carrying capacities for teachers and classified employees depend strongly and *directly* on enrollments. The carrying capacities for the other two components, $A$ and $P$, react more to factors *internal* to the work organization and only weakly to enrollments. The direct effects of enrollments on $A$ and $P$ are much smaller than would be required to generate directly the levels of $A$ and $P$ reported in Table 1. Thus it appears that we have two components specialized to adapting to

**Table 3. Estimated Niche Parameters (Effects on Carrying Capacities).**

| | | | | | |
|---|---|---|---|---|---|
| Growth $T$ = 1.80 | | | +.616P | +.156C | +.0569E |
| Decline $T$ = .756 | | +1.90A | | | +.0388E |
| Growth $A$ = .050 | +.071T | | −.136P | −.004C | +.0011E |
| Decline $A$ = .133 | +.076T | | | | +.0003E |
| Growth $P$ = .870 | +.127T | | −.006P | | |
| Decline $P$ = .306 | +.115T | −.016A | | −.038C | +.0011E |
| Growth $C$ = 4.89 | | | | | +.0510E |
| Decline $C$ = 3.40 | −.152T | +5.54A | −2.14P | | +.0441E |

*Note:* See Table 1 for explanation of categories ($T$ = Teachers).

**Table 4. Total Effects of Enrollments (E).**

| | *Growth* | *Decline* |
|---|---|---|
| *T* | 3.35 + .0702E | 1.18 + .0445E |
| *A* | .113 + .0049E | .222 + .0032E |
| *P* | 1.29 + .0086E | .293 + .0046E |
| *C* | 4.89 + .0510E | 5.08 + .0637E |

*Note:* See Table 1 for explanation of categories (*T* = Teachers).

direct variations in enrollments. The other two, *A* and *P*, are specialized to adapting to flows of resources mediated by *T* and *C*.

This clear difference, that characterizes both growth and decline, leads us to rethink our earlier classification scheme. We followed the literature in distinguishing between a production component that does the legitimated work of the organization and a supportive component that services and buffers the direct component. We treated only teachers as direct component staff. Classified employees were treated as supportive staff. But the estimates in Table 3 belie this classification. It appears that both teachers and classified employees are doing the production work in these organizations. We infer this from the fact that the carrying capacities for only these two components depend directly (in a strong way) on the demand for the services of the organization. The mix of workers involved in *C* (bus drivers, janitors, cafeteria employees, clerks) is relatively heterogeneous. Yet there are many that are directly tied to the volume of students. So we have no difficulty accepting the classification suggested by the results, that *C* is part of the direct component.

In three of four cases, the direct effect of enrollments is larger in growth (*P* is the only exception). This is true both for *T* (where we expected no such difference) and for *A* (where the ratchet analogue suggests a reverse ordering). But, these direct-effect measures do not tell the whole story. As we have indicated, the effects of enrollments are mediated by *T* and *C*. More generally, environmental effects reverberate through the competitive structure. So it is natural to investigate the effects of enrollments on a steady state. To do this, we calculate *total effects* by solving the systems of equations (for growers and decliners) in Table 3 for $T^*$, $A^*$, $P^*$, and $C^*$ as functions only of *E*.

The total effects of enrollments are presented in Table 4. The simple reasoning about the difference between growth and decline does not fare any better when we consider total effects. It is easier to see this from another calculation. In Table 5, we indicate the predicted equilibrium levels for each component in a school district with 10,000 students (the results for districts of other sizes will not differ much, since the constants are so small). The second and fourth columns of Table 5 record the levels for each component that would be expected from the ratios in the 1975 data (for example, from ratios of $T$ to $ADA$). The differences between the predictions and the 1975 observations give an indication of how far the districts are from equilibrium. We first discuss the predictions for growth and decline and then consider the issue of distance from equilibrium.

The predicted equilibrium level for teachers in decline is initially the same as that observed in the data, an average class size of approximately 22.5 students. For growing districts, the predicted equilibrium level of $T$ gives an average class size of approximately 14.3. Similar differences hold for $A^*$. However, the $A^*/T^*$ ratio would not be much changed under these predictions. In fact, the ratio of administrators to teachers is predicted to be slightly higher in decline, .072, than in growth, .069. Similarly, the predicted $A^*/P^*$ ratio is also larger for decline, .70 versus .56.

Only for the classified staff does the model predict higher equilibrium levels in decline. However, the predicted $C^*$ for both growth and decline are very much higher than current levels.

What do we make of these results? It is difficult and perhaps unwarranted to conclude more than that growth and decline pro-

**Table 5. Predicted Levels of Personnel Components in Equilibrium (Enrollments = 10,000).**

| | *Growth* | | *Decline* | |
|---|---|---|---|---|
| | *Predicted* | *1975 Observed* | *Predicted* | *1975 Observed* |
| Teachers | 705 | 430 | 446 | 480 |
| Administrators | 49 | 27 | 32 | 35 |
| Public service employees | 87 | 29 | 46 | 27 |
| Classified employees | 515 | 245 | 642 | 294 |

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cesses differ for these organizations. We hesitate to make more of the findings than this broad conclusion for several reasons. The predicted equilibria for several categories are very far from current observed levels. Thus the prediction is really an extrapolation quite far beyond the data used to estimate model parameters. Under such conditions, the linearity we imposed for simplicity becomes quite important. Departures from linearity (either in the dynamic model or in the behavior over time of the exogenous variable) may produce only slight distortions in predictions to nearby equilibria. When, on the other hand, the predicted equilibria are distant, departures from linearity may give completely misleading results.

There is a second, more substantive, issue. Suppose these results give accurate predictions of the carrying capacities toward which the components are adjusting during the period studied. We find it hard to believe that the environment would not intervene were these tendencies revealed over a sustained period. If, for instance, the number of classified employees or teachers continually grew out of proportion to the size of the organizations, we would expect the communities that finance these organizations would take action to alter the growth process. In short, we doubt that growth on the order predicted here is politically feasible. In work in progress, we are incorporating financial variables and using longer lag periods in an effort to understand more clearly the environmental factors affecting carrying capacities. Meanwhile, we must treat the findings reported here as quite tentative. To repeat, it is unwise to conclude more than that growth differs from decline.

*Partial Adjustment.* Finally, we consider estimates of the speed with which each component adjusts to changes in its carrying capacities: that is, to changes in environmental conditions and to the sizes of competitors (and facilitators). The relevant parameter was denoted by $r$ in (5). Recall that $r$ indicates the fraction of the gap between current size and current carrying capacity that is reduced in a year. The estimated $r$'s are found in Table 6.

We find that two components, $A$ and $C$, are almost equally responsive in growth and decline. Administration adjusts about half way each year, while the size of the classified staff adjusts only about a fifth of the way. For the other two categories, $T$ and $P$,

**Table 6. Estimates of *r*, the Responsiveness Parameter.**

| | *Growth* | *Decline* |
|---|---|---|
| Teachers | .441 | .258 |
| Administrators | .523 | .588 |
| Public service employees | .322 | .183 |
| Classified employees | .192 | .211 |

adjustment is considerably faster in growth. That is, they respond more quickly to an increase in carrying capacity than to a decrease.

This is not what we had expected. Our expectation was that administrators would respond more quickly in growth and that the response of teachers would not much differ in growth and decline. Nor did we expect that administrations would be more responsive than all the other categories. Now, however, it is clear where we went wrong. Previously, we thought of each personnel component as adjusting to exogenous demand. But we saw earlier that the carrying capacity for administration is not strongly and directly affected by changes in environmental demand. Rather, it responds to the sizes of other personnel components. This is particularly true for decline. And, in growth and decline, $A^*$ is responsive to different conditions. In growth, $A^*$ depends on all the other components: $P$ and C impede $A$'s growth. In decline, $A^*$ depends only on $T$. Thus the conditions to which the component responds are quite different. In growth, it is in part a response to competition (lowering $A^*$). In decline, there is no competition. Consequently, there is no reason to expect that $r$ for growth would be greater than $r$ for decline. Our previous reasoning did not take such complexities into account.

It is worth noting that the dynamic behavior of the whole system will differ in growth and decline due to the differences in $r$ for $T$ and $P$. The difference for $T$ is undoubtedly more important. Recall that environmental demand is mediated largely by $T$ and $C$. So the fact that $T$ in declining districts responds slowly suggests that *response to decline will be slower throughout the system.*

Returning to the issue of the responsiveness of $A$, in decline, as we have seen, $A^*$ responds only to $T$ (and only very slightly on

the environment). The fact that $T$ responds slowly in decline implies that *$A$ also responds slowly to environmental changes in decline.* From this perspective, the ratchet effect we posited previously appears to hold for the dynamics of the response of $A$ to changes in demand for the services of the organization. But the ratchet effect holds because of differences in responsiveness of the size of the teaching staff and because of growth-decline differences in the competitive structure.

## Discussion

We find broad differences between growth and decline in all three of the subprocesses studied: (1) Competitive interactions are stronger on average in decline, (2) carrying capacities for most personnel components are lower at a given level of enrollment in decline, and (3) the organizational systems respond more slowly to environmental changes in decline. Any one of these findings would be enough to sustain our earlier contention that the growth and decline processes differ. The fact that all three differ is dramatic evidence. Thus analysis of the revised model reinforces our earlier critique of the wholesale failure in the organizations literature to distinguish growth and decline processes.

By making the model fully political, we have obtained results that are more complex than in our earlier work. The growth-decline difference is now more pervasive since the pivotal teaching component behaves differently in growth and decline. The main analytic consequence of this difference is to vitiate some of our earlier reasoning. In particular, we must discard the argument for a "norm of constant class size" that implies symmetric growth and decline for the teaching component. Abandoning this simplification complicates attempts at contrasting patterns, as there is now no stable baseline.

What remains of our earlier argument about the specific differences between growth and decline? Our general argument was that organizational politics would distort the decline process. The more specific argument was that the supportive component resists decline (while the teaching staff does not) so that ratios of supportive staff to teachers will be higher at the same level of en-

rollments in decline. We conclude that the results support the broad argument; the politics are different in decline. We see this in two ways. First, the strength of competitive interactions is stronger in decline. The structure of competitive interactions also changes with administration shifting to a more dominating position. These changes, taken together, suggest that adjustments in the sizes of components are made less on the basis of administrative rationality and more on the basis of political struggles among components in decline. Second, the systems respond more slowly to decline. It is clearly in the narrow interests of each component, but not administratively rational, to resist decline. The fact that response is slow in decline suggests that the personnel components are at least partially successful in enacting these interests. In these respects, the organizational politics work in the way we anticipated.

It is more difficult to assess the specific argument concerning relative sizes of supportive and direct components in growth and decline. We classified only administration and pupil services as supportive and teachers and classified employees (on the basis of empirical results) as the direct component. We find that the predicted ratio of administrators to teachers increases slightly in decline. However, the ratio to teachers and classified employees is smaller in decline. For the pupil service category, both ratios are larger in growth. But both $A$ and $P$ respond more slowly than $T$ and $C$ in decline. For $P$, we see this merely by inspecting $r$. For $A$, we must recall that $A$ responds almost solely to $T$ in decline. Thus $A$'s response is some fraction of $T$'s response. So the short-run behavior of the two supportive components may give rise to ratchetlike effects when districts cycle between spells of growth and decline. Otherwise, the long-run equilibria predictions do not support our earlier hypothesis. We must add again the caution that these predicted equilibria are the most delicate of our findings. Departures from linearity in particular may rob these calculations of much value. Therefore, the conclusions regarding equilibrium levels of components should be treated as very tentative.

There are two important premises underlying the changes we have introduced into our model. First, we assume that each personnel component is organized in a self-interested way. Administrators take care of their own, and so do teachers and the rest.

Second, we assume no functional priority among them. Whether teachers are more necessary to the operation of school districts than nonteaching professionals is, of course, arguable. We believe such arguments occur regularly in most school districts. How they come out is a matter that depends on political power more than anything else. So we see these population components very much as we see social classes, ethnic groups, and other social collectivities that compete for scarce resources.

In this respect, our work draws on a variety of sources. From political economy, we draw our emphasis on internal competition for resources, status, and power. The work of Michels ([1915] 1949) is clearly relevant here. In this volume, Chapter Two, by Pfeffer, on micropolitics, is complementary. Similarly, Chapter Four, by Meyer and Rowan, argues that institutionalized rules, rooted in the environment rather than any functional necessity born of an established technology, explain why schools are the way they are. We agree with them, although we see these rules as subject to political negotiation rather than as institutional "givens." Although their perspective is static, explaining why things are as they are rather than how they came to be that way, we probably do little violence to their argument by noting that we and they would probably both agree that it is when environmental shocks are experienced that breakdowns are observed in the precedents and traditions on which normative consensus rests. Finally, these ideas have much in common with those of Cohen, March, and Olsen (1972), March and Olsen (1976), and Weick (1976). We do not assume that school districts have well-known goals. We do assume that they have no well-understood technology and that participation is variably fluid over time and across population components. So, in many respects, we see school districts (and their constituent schools) as organized anarchies. Organizational demography is not the simple outcome of administrative rationality. It is the lack of deterministic standards by which decisions are made, coupled with competition for scarce resources, that contributes the political quality to these organizations. In organizations with clear-cut goals, using well-understood technologies, in which participants and nonparticipants are clearly differentiated, we would expect fewer of

the issues driving demographic dynamics to be "up for grabs." And they should come closer to what would be expected under rationalist assumptions.

These observations serve to place this research in perspective. The degree of politicization is variable across the universe of all organizations. Further research in a variety of organizational contexts will be required before we know how much the models advanced in this chapter can tell us about organizational dynamics in general.

The model we have worked with in this chapter implies internal political process but it also suggests external political process as well. When organizations differ in growth and decline, as California school districts clearly do, the aggressiveness with which they seek out resources can be expected to differ. In this continuing line of research, we plan to expand the analysis to take resource constraints into account. But we should note that school districts may adopt entrepreneurial behavior patterns in order to build up the slack they use to keep internal competition in check. Where these resources come from has much to do with the uncertainties and constraints on the organization. Federal money, for instance, often mandates clerical and administrative effort. This is to say that it has bureaucratic strings tied to it. Money raised at the school site level (for example, from PTA activities and building rentals) often has no such bureaucratic strings but does carry with it uncertainty generated by unstable participation of parents and other contributors.

Work currently in progress should place these issues in a sharper light. In the interim, we conclude that the revised model (and estimation procedures used here) yield an improved understanding of the complex ways in which organizational demography responds to variations in environmental demand for services. This research highlights the preeminently political character of organizational demography and suggests the value of further research on the micropolitics of organizational demography.